# Equitable Child Health Interventions

## The Impact of Improved Water and Sanitation on Inequalities in Child Mortality in Stockholm, 1878 to 1925

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**Today, many of the 10 million childhood deaths each year are caused by diseases of poverty—diarrhea and pneumonia, for example, which were previously major causes of childhood death in many European countries. Specific analyses of the historical decline of child mortality may shed light on the potential equity impact of interventions to reduce child mortality.**

**In our study of the impact of improved water and sanitation in Stockholm from 1878 to 1925, we examined the decline in overall and diarrhea mortality among children, both in general and by socioeconomic group. We report a decline in overall mortality and of diarrhea mortality and a leveling out of socioeconomic differences in child mortality due to diarrheal diseases, but not of overall mortality. The contribution of general and targeted policies is discussed. (*Am J Public Health.* 2005;95:208–216. doi: 10.2105/AJPH.2003.034900)**

**IN A RECENT SERIES OF PAPERS** on child survival in the *Lancet*,[1–4] neonatal causes, diarrhea, and pneumonia were quoted as major causes of the 10 million childhood deaths that occur each year.[1] In spite of evidence that interventions reduce mortality, the coverage of such interventions is still too low,[2] and the delivery of services is not sufficient.[3] In addition, poor children are disadvantaged in terms of exposure to and resistance to disease, coverage levels for preventive interventions, and use of health care when they are sick.[4] A major issue for many governments is how to reduce mortality and ensure that interventions to reduce mortality also reach poor children.

Diseases such as diarrhea and pneumonia are diseases of poverty,[1] and they were major causes of childhood death in many European countries a century ago. Specific analyses of the historical decline of child mortality in these countries may shed light on the potential overall and equity impact of certain interventions to reduce child mortality, such as improvement of water and sanitation. The historical time period and cause-specific patterns of child mortality may also be informative. Previous studies of infant mortality in Stockholm from 1878 to 1925[5] showed a transition over time in the age structure and cause-specific composition of mortality analogous to the country typology described[1]; diarrhea and pneumonia initially were the main causes, and as they declined, neonatal causes subsequently increased in relative importance. Infant (< 1 year) mortality rates exceeded 200 per 1000 in Stockholm until 1900 and declined to 50 per 1000 by 1925. Most of the decline, which occurred in the postnatal (1–11 month) period, was driven by a decline in diarrhea mortality. Other important causes of death included congenital conditions; tuberculosis; meningitis; undernutrition; and other diseases associated with poverty, crowding, and adverse living conditions, which were a reality for the majority of the rapidly growing urban population in Stockholm.[5]

There were probably many causes of the decline in diarrhea mortality; improvements in the provision of water and sanitation, changes in hygienic perception and behavior, and general socioeconomic improvements, including improved nutritional status, are all thought to have been contributing factors.[6] Obviously, the mortality decline occurred in the absence of other specific interventions such as immunization and effective curative interventions.

Against this background, we analyze the impact of improvements of water and sanitation in Stockholm from 1878 to 1925 on overall mortality and diarrhea mortality, both in general and by socioeconomic group.

## DECLINE IN CHILD AND INFANT MORTALITY IN STOCKHOLM

### Background

The historical decline of infant and child mortality in European countries previously has been

studied extensively.[7,8] Other Swedish studies have addressed the issue, as well as the importance of health reform to the decline.[9–13] However, few studies have investigated the mortality decline in Stockholm.[14,15] In a recent study of health reforms in Swedish towns from 1875 to 1910, Edvinsson and Rogers studied the correlation between investments in the health care sector, sanitation, and water and changes in infant mortality.[16] They found a correlation between infant mortality and investments in health care (the creation of epidemic wards in hospitals), but not investments in water and sanitation.[16]

The McKeown thesis[17] states that improved nutrition and a general rise in the standard of living were the main explanations of the historical decline of child mortality in Europe. While this thesis was once generally accepted, it has now been questioned. Szreter argued that although an improved standard of living was important, organized public health and sanitary reform, including specific interventions such as improved water and sanitation, were crucial for the improvement of health.[18,19] Nathanson,[20] building on Szreter's work, further proposed that the implementation of health and sanitary reforms depends on the type of governance and is facilitated in highly centralized states.

## Water Supply

Before 1860, the population of Stockholm got its water from wells and from surface water. Piped water was introduced to improve hygiene, reduce the risk of epidemics, enhance industrial access to water, and provide water for fire fighting. The first part of the water works opened in 1861. A total of 120 water posts providing water free of charge were installed across the city, and water pipes were extended to all inhabited parts of the city. Piped water became available indoors and in courtyards, streets, and squares.[21] An investigation of the housing conditions of the working classes in 1896 showed that almost half of all apartments inhabited by workers in the area studied had piped water in the apartment building, and more than one third had a tap in the courtyard; 14% of the apartments had no access to piped water on the premises.[22]

## Disposal of Excreta

Following the last cholera epidemic in Stockholm in 1853, which left 3000 dead, public opinion for improved sanitation resulted in the establishment of a new sanitation office, which was charged with managing excreta disposal efficiently and cleaning streets and yards belonging to the city. A new sanitation ordinance was established in 1874.[12] Sanitation routines were reviewed to increase the effectiveness and efficiency in the work. In the first half of the 19th century, excreta had been emptied into cesspools in the city. The last cesspool was closed in 1894. Increasingly, excreta was transported away from the city to central latrine terminals, from which some of it was sold as manure to farmers. Further legislation in 1892 regulated latrine vessels and their cleaning. New and uniform latrine vessels were introduced that could more easily be transported and cleaned. The collection and transport of the vessels was also made more efficient. Through changes made in the 30 years leading up to the early 1890s, excreta disposal in Stockholm was developed from an almost medieval system to a hygienic standard acceptable for the 20th century.[23]

> *"In spite of evidence that interventions reduce mortality, the coverage of such interventions is still too low[2] and the delivery of services not sufficient.[3] In addition, poor children are disadvantaged in terms of exposure to and resistance to disease, coverage levels for preventive interventions, and use of health care when they are sick."[4]*

In 1880, there were about 30 000 outdoor privies and the same number of indoor privies. The number of indoor privies increased to nearly 100 000 by the turn of the century. The number of collected vessels increased from about 120 000 in 1870 to a peak of almost 700 000 vessels in the period 1900 to 1910. Over the same period, the population of Stockholm nearly tripled, from 135 000 in 1870 to 340 000 in 1910. Sharing communal privies became less common. At the end of the 19th century, 3 of every 4 families had a privy at their private disposal, and only 3% shared facilities with more than 1 other family.[22] From 1910 onward, the number of water closets increased, while the number of outdoor and indoor privies successively decreased.[23]

### Sewerage System

In the 1850s, wastewater was discharged into open ditches, some covered with planks or stones. The sewerage system was not developed in coordination with the piped water system, but some 10 to 20 years later. By the end of the 19th century, the central parts of the city had sewerage, still mainly for wastewater only. In 1895, there were only 40 premises in the city with water closets. By 1904, this number had increased to 1506, and in 1909 the city decided to grant permission to connect water closets to the municipal sewerage system. In 1909, a second sewerage plan was launched, and a first wastewater treatment plant was constructed.[23]

### Other Improvements

Economic development improved from the end of the 1890s onward, with recessions in 1906/07 and during World War I. The 1880s had been "the dark, desperate, impossible decade,"[24(p38)] with widespread malnutrition among the working class. In the 1890s, people had better opportunities for improved nutrition—not only because there was more money for food, but also because women could stay home to cook. At the turn of the century, prices increased, and a recession followed in 1906/07. In spite of temporary economic setbacks (particularly during World War I), living conditions improved, and class inequalities were reduced, primarily owing to improvements in the economic position of the working class.[24]

From the 1890s, the principles for governing the city changed from being purely economic to including concern for the health of the population.[25] A "sanitary police" department was instituted as part of the new emphasis on improvements in environmental hygiene. This authority was charged with inspecting food and milk and checking adherence to a local ordinance mandating the cleanliness and tidiness of outdoor premises. The department made 50 000 to 100 000 inspection visits a year. A voluntary organization modeled on the Sanitary Institute of Great Britain (the Public Health Association) was formed in 1881, bringing together physicians, lawyers, scientists, and engineers with representatives of charitable organizations. It became an influential body that pressed local policymakers to make improvements conducive to health. In the early 20th century, local organizations inspired by philanthropic baby care in other European countries were also formed. They emphasized the promotion of breastfeeding and the distribution of controlled milk to infants and children when breastfeeding was not possible.[26]

## DATA AND METHODS

We obtained information concerning the provision of piped water from historical records of the Stockholm city water works. The child mortality analysis is based on individual entries from computerized records originally collected for civil registration purposes in Stockholm for the years 1878 to 1925 (the Roteman Archives). These records include the child's sex and date of birth; the date of the child's entering the parish and moving out of the parish or death; and the child's age when these events occurred. Individuals are identified by their name and date of birth. Members of the same household are kept together through a special file number given to the household in the original register.

From this information, we used individual data on date of birth, date of moving into and out of the parish, the occupational title of the head of the household, and the date of death. These data were linked to computerized death certificates with information on the cause of death, through the date of birth and another identity number. The death certificates were filled out by physicians and include the name, date of birth, date of death, and primary and secondary cause of death. The data cover the period from 1878 to 1925, a very dynamic time in the history of Stockholm. Information for all residents of Södermalm (an island in central Stockholm) during this period has been computerized. The data set includes all children aged birth to 9 years who resided for some period of time in Södermalm—in all, 88 157 children before 1900 and 102 814 children from 1901 to 1925 (a total of 724 253 person-years of follow-up and 16 574 deaths among the children aged birth to 9 years). The population of Södermalm, which was predominantly working class, increased from about 50 000 in the 1870s to 120 000 in the 1920s. In a contemporary investigation, the 2 parishes of Maria and Katarina on Södermalm had higher rates of infant and child mortality than most other parishes in Stockholm.[14]

This study focuses on deaths due to diarrhea. Since 94% of the children who died from diarrhea were aged younger than 2 years, we restricted the study to this age group. The study included children aged younger than 2 years residing for some period of time in Maria and

Katarina parishes during the study period (1878–1925). The outcome measure was death among children, measured as the incidence rate of death. Age- and cause-specific mortality rates were calculated for each year of study, and data were pooled into periods of years (1878–1883, 1884–1889, 1890–1895, 1896–1900, 1901–1908, 1909–1917, 1918–1925). Children could enter the follow-up by living in the parish from the start or by being born in or moving into the parish during the follow-up period. Each child was followed for a maximum of 365 days per year or until the day of death or moving out of the parish.

### Classification of Cause of Death

From 1860 onward, deaths of residents in Stockholm were certified by doctors. As indicated on the death certificate, the death of 1 child may have more than one cause and may thus be counted under more than 1 cause of death. However, the overall death rates were not affected by this classification—a child's death was counted only once. Death due to diarrhea was defined as a death caused by cholera, colitis, diarrhea, gastritis, gastroenteritis, enteritis, intestinal inflammation, or typhoid fever. By this classification, diarrhea was 1 of the main causes of death. Out of the total 16 574 deaths, 3799 (22.9%) were due to diarrhea. Among children younger than 2 years, the proportion of deaths due to diarrhea was 30.2% (3569 out of a total 11 816).

### Classification by Socioeconomic Group

The occupational title of the head of household from the original data (translated into a Historical International Classification of Occupations [HISCO] code for the particular title)[27] was used for a subsequent classification into socioeconomic group, based on the Erikson Goldthorpe system of classification.[28] The 11 Erikson Goldthorpe categories were subsequently merged into 5 socioeconomic groups: group 1—higher and intermediate nonmanual group (5.9% of the sample); group 2—lower nonmanual group (9.1%); group 3—skilled manual workers (23.3%); group 4—unskilled manual workers (33.2%); group 5—persons lacking a HISCO code or not working (28.5%). This last group largely consisted of households headed by women who had no profession (68%); 49% of children in these households were born out of wedlock. The same coding of socioeconomic group was applied for the entire study period.

### Analysis

The overall mortality rates and diarrhea mortality rates, calculated by year, are presented as incidence rates per 1000 person-

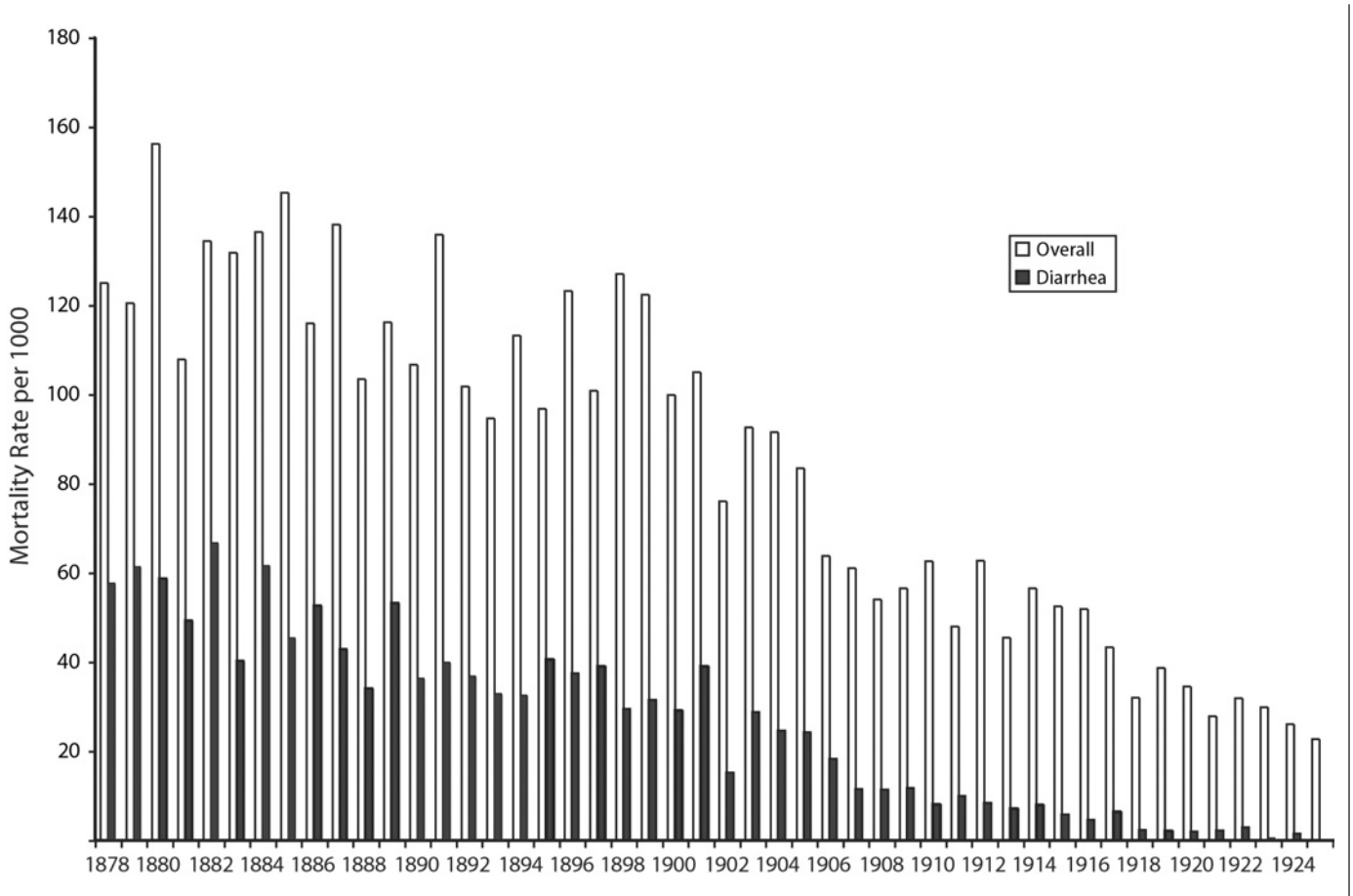


**FIGURE 1—Overall mortality and diarrhea mortality among children aged younger than 2 years: Stockholm, 1878 to 1925.**

years. Subsequently, overall mortality rates and diarrhea mortality rates were calculated by socioeconomic group and time period, with the individual years aggregated into 7 time periods. Finally, Cox regression analysis was used to obtain the hazard of death (referred to as relative risk of death) by socioeconomic group in relation to the hazard of death of children in socioeconomic group 1. Analyses were done with SAS software, version 8.1 (SAS Institute Inc, Cary, NC).

## RESULTS

The overall mortality rate declined from an average of 130 per 1000 in the period 1878 to 1882 to 31 per 1000 in 1918 to 1925, while the diarrhea mortality rate declined from 59 per 1000 to 2 per 1000 over the same time (Figure 1). Figure 2 shows the cumulative expansion of new water pipes and the daily average water consumption per capita in relation to the annual diarrhea mortality rate from 1878 to 1925. By 1900, more than half of all new pipes were in place, and nearly all of the 7000 water pipe connections installed from 1875 to 1920 were completed by 1915. Average daily water consumption increased from about 40 L per person in the beginning of the period to about 80 L per person by 1900; it declined to about 60 L per person in 1920. The decline in water consumption after the turn of the century was partly due to the introduction of water meters that determined cost at the point of consumption and to thrift campaigns during World War I.[29]

The decline of diarrhea mortality rates and the relative risk of mortality by socioeconomic group and time period are shown in Figures 3 and 4 and in Table 1. In the first period, 1878 to 1882, the diarrhea mortality rate for children in socioeconomic group 4 was about 50% higher than the rate for children in group 1. The diarrhea mortality rate among children in group 5 (whose parents either were not working or lacked an HISCO code) was more than twice that of children in group 1. Although the absolute mortality rates declined and the rate differences varied over time, this pattern continued until the 2 last periods (1909–1917 and 1918–1925), when there was no longer an evident stepwise socioeconomic pattern in diarrhea mortality. In the period 1909 to 1918, the diarrhea mortality rates of children in socioeconomic groups 2, 3, and 4 were similar to the rate for children in group 1. The rate was still higher in group 5 than in group 1 in the period 1909 to 1918, but from 1918 to 1925, there were no significant socioeconomic differences in diarrhea mortality.

The socioeconomic differences in overall mortality rates and relative risk of mortality over time, shown in Figure 4 and Table 1, are similar to the pattern of diarrhea mortality in the earlier time periods. However, unlike the pattern in diarrhea mortality, the stepwise socioeconomic gradient in overall mortality rates by socioeconomic group remained throughout the study period, and the differences were statistically significant from 1918 to 1925.

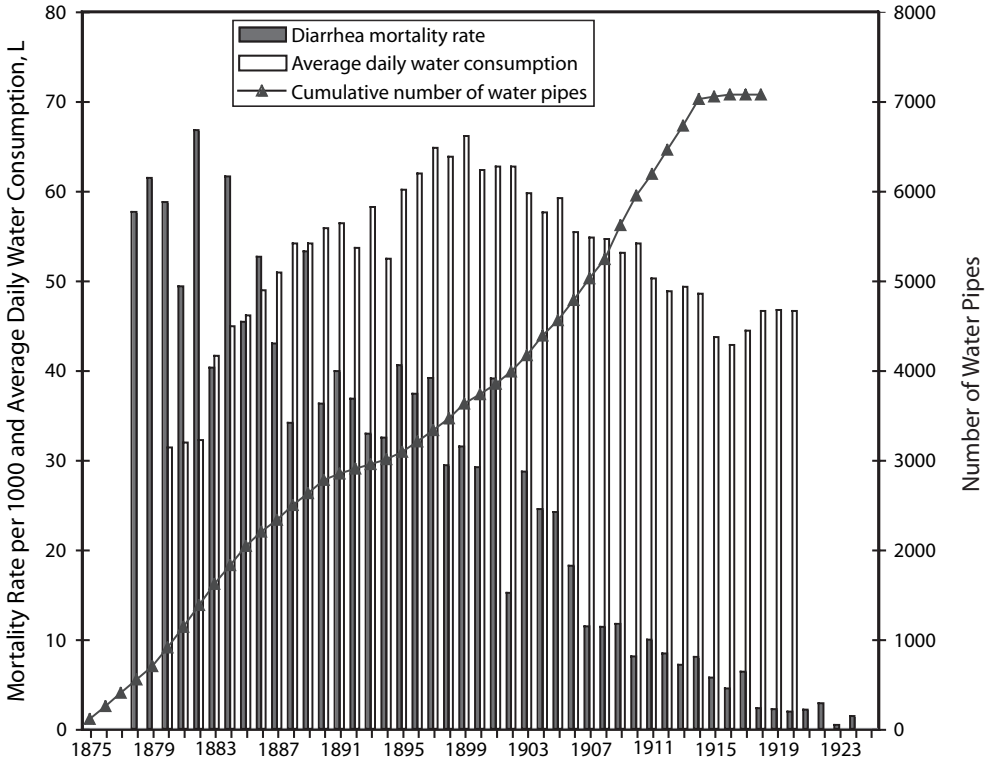


**FIGURE 2—Diarrhea mortality rate in relation to daily average water consumption per person and cumulative number of new water pipe connections, Stockholm, 1878 to 1925.**

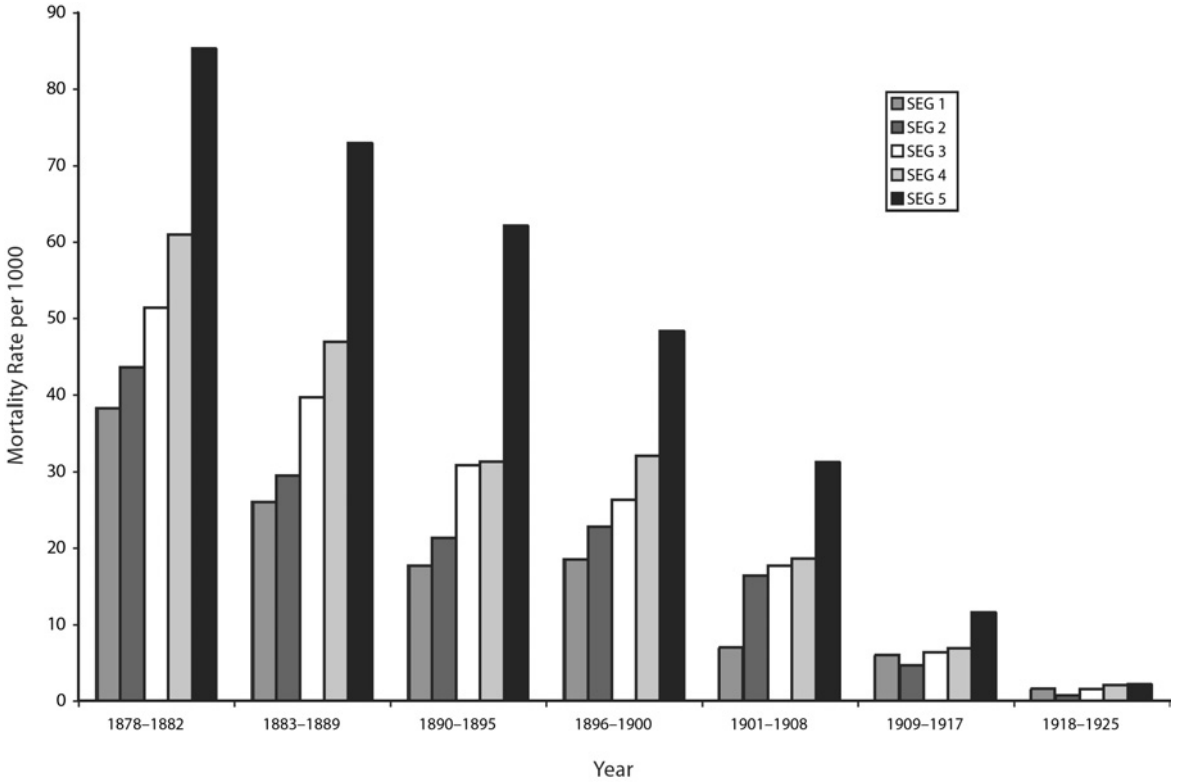


**FIGURE 3—Diarrhea mortality rates among children aged younger than 2 years, by socioeconomic group (SEG), Stockholm, 1878 to 1925.**

*Note.* Groups are numbered in order of descending socioeconomic status.

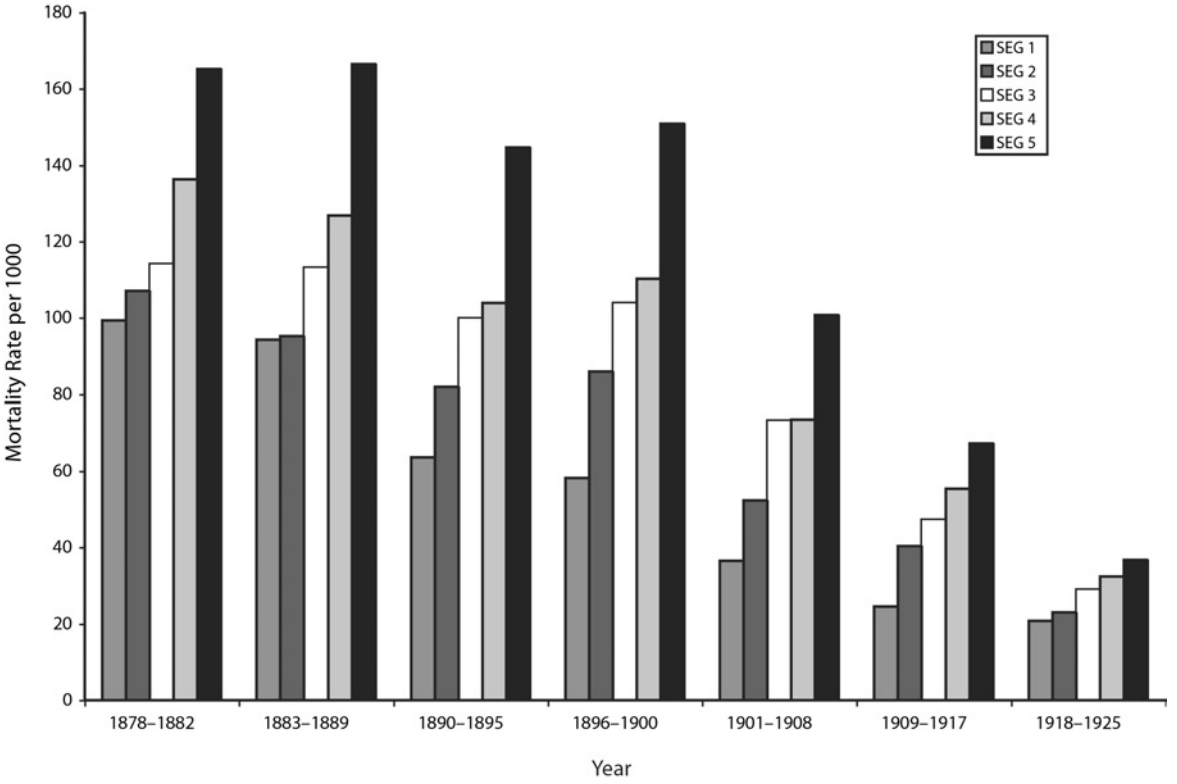


**FIGURE 4—Overall mortality rates among children aged younger than 2 years, by socioeconomic group (SEG), Stockholm, 1878 to 1925.**

*Note.* Groups are numbered in order of descending socioeconomic status.

**TABLE 1—Relative Risk of Diarrhea Mortality and Overall Mortality Among Children Younger than 2 Years, by Socioeconomic Group: Stockholm, 1878 to 1925**

| Socioeconomic Group[a] | 1878–1882, RR (95% CI) | 1883–1889, RR (95% CI) | 1890–1895, RR (95% CI) | 1896–1900, RR (95% CI) | 1901–1908, RR (95% CI) | 1909–1917, RR (95% CI) | 1918–1925, RR (95% CI |
|---|---|---|---|---|---|---|---|
| **Diarrhea mortality** | | | | | | | |
| 1 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| 2 | 1.1 (0.7, 1.8) | 1.1 (0.7, 1.8) | 1.2 (0.6, 2.3) | 1.2 (0.6, 2.4) | 2.3 (1.1, 4.9) | 0.8 (0.4, 1.6) | 0.4 (0.1, 2.7) |
| 3 | 1.3 (0.9, 2.0) | 1.5 (1.0, 2.3) | 1.7 (1.0, 3.0) | 1.4 (0.8, 2.5) | 2.5 (1.3, 5.0) | 1.1 (0.6, 2.0) | 1.0 (0.2, 4.2) |
| 4 | 1.6 (1.1, 2.3) | 1.8 (1.2, 2.7) | 1.8 (1.0, 3.0) | 1.7 (1.0, 3.0) | 2.7 (1.4, 5.2) | 1.1 (0.6, 2.1) | 1.3 (0.4, 4.9) |
| 5 | 2.2 (1.5, 3.2) | 2.8 (1.9, 4.1) | 3.5 (2.1, 5.8) | 2.6 (1.5, 4.5) | 4.4 (2.2, 8.5) | 1.9 (1.0, 3.4) | 1.3 (0.4, 4.5) |
| **Overall mortality** | | | | | | | |
| 1 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| 2 | 1.1 (0.8, 1.4) | 1.0 (0.8, 1.3) | 1.3 (0.9, 1.8) | 1.5 (1.0, 2.1) | 1.4 (1.0, 2.0) | 1.7 (1.2, 2.3) | 1.1 (0.8, 1.6) |
| 3 | 1.1 (0.9, 1.5) | 1.2 (1.0, 1.5) | 1.6 (1.2, 2.1) | 1.8 (1.3, 2.4) | 2.0 (1.5, 2.7) | 1.9 (1.4, 2.6) | 1.4 (1.0, 2.0) |
| 4 | 1.4 (1.1, 1.7) | 1.3 (1.1, 1.6) | 1.6 (1.2, 2.1) | 1.9 (1.4, 2.6) | 2.0 (1.5, 2.7) | 2.3 (1.7, 3.0) | 1.6 (1.1, 2.2) |
| 5 | 1.6 (1.3, 2.1) | 1.7 (1.4, 2.1) | 2.2 (1.7, 2.9) | 2.5 (1.8, 3.4) | 2.7 (2.0, 3.6) | 2.6 (2.0, 3.5) | 1.7 (1.2, 2.3) |

*Note*: RR = relative risk; CI = confidence interval.

[a]Numbered in order of descending socioeconomic status.

## DISCUSSION

There was a remarkable decline in overall child mortality, and particularly diarrhea mortality, in Stockholm from 1878 to 1925. The decline in diarrhea mortality was initially more rapid in the highest socioeconomic group than in the lower socioeconomic groups, causing increased social differentials. However, there was soon considerable improvement among children in the other socioeconomic groups, not least in the periods 1890 to 1895 and 1909 to 1917. In the last period, there was no significant difference by socioeconomic group in the risk of dying from diarrhea. Diarrhea mortality was virtually eliminated by 1925, after having been one of the major causes of infant and childhood death before the turn of the century. The fact that death from diarrhea mainly affected infants suggests that breastfeeding was not generally practiced during the first months of life. The average age of death from diarrhea was 6 months before 1900 and 5.4 months after 1900. Children born out of wedlock died slightly younger than those born within wedlock. Unfortunately, data on the prevalence of breastfeeding in Stockholm are very scarce, but a survey of the whole of Sweden in the 1870s stated that there was "partial breastfeeding" in Stockholm,[30] and the intensive campaigns by doctors against bottle feeding support that statement.[29]

It may be difficult to disentangle the precise role of the different factors that brought about the decline in diarrhea mortality around the turn of the century or what caused the equalization of mortality risks. However, the decline of diarrhea mortality in Stockholm illustrates some features of the relationship between improvements in water and sanitation and the decline of diarrhea. Large interventions involving expansion of access to water and concurrent improvements in sanitation, such as described in Stockholm, have been found to have greater impact than more limited interventions. Few studies have analyzed the impact of water and sanitation on diarrhea mortality, although the impact on severe diarrhea and mortality is hypothesized to precede the impact on morbidity.[31] In Stockholm, the decline of diarrhea mortality was quite rapid, but we have no records of the diarrhea morbidity rates. However, some studies suggest that sanitation is more important than water.[31,32]

Another factor likely to have had great importance to the decline of diarrhea mortality in Stockholm was the strong local political commitment to improvements in the sanitary environment, public education, and the enforcement of sanitary laws and regulations. Technical improvements in water and sanitation may not be sufficient unless accompanied by changes in health behavior. In Stockholm, several beneficial developments took place simultaneously that seem to have acted synergistically in reducing diarrhea mortality. The enforcement of the local sanitary ordinance appears to have been extensive and forceful, and the universal application of interventions regarding improved water supply and improved sanitary en-

vironment seems to have benefited the lower social classes as much as, or more than, the higher social classes.

Regarding recent debates on the health effects of different sanitation interventions in nonindustrialized countries,[33,34] it is evident that in Stockholm most of the diarrhea mortality decline occurred before the expansion of water closets. Hence, water closets do not appear to be indispensable in reducing diarrhea mortality.

From the early 1890s, young children became a target for city health policies. A socioeconomic gradient prevailed throughout the study period for overall mortality rates, while it diminished in the last 2 time periods for diarrhea mortality rates. This fact suggests that improvements in water and sanitation and related interventions conducive to the decline of diarrhea mortality that were implemented concurrently resulted in an equalization of the mortality risk from diarrhea but not in the risk of death from other causes. These interventions included higher standards of cleanliness of public areas, improved handling of excreta, intensified health inspection, milk inspection, better food handling, improved child feeding practices, and health education to improve hygienic practices. Furthermore, most of these improvements and interventions were implemented universally and not in a targeted way. Some specific reforms, however, were designed to support single mothers of illegitimate children and to foster families.[29]

Conversely, the equalization of mortality risks suggests that the lower socioeconomic groups benefited to a greater extent from the universal interventions than did the higher socioeconomic groups. Higher socioeconomic groups, however, are likely to have gained access to piped water earlier than lower socioeconomic groups, since water pipe connections had to be paid for by the proprietor. As others have shown previously, the decline of mortality is often accompanied by an increase in relative mortality differentials.[35,36] However, over time, these differentials diminished in Stockholm. Our findings regarding diarrhea mortality are similar to those of Troesken,[37] who studied the impact of improved water and sanitation on survival rates in African American households in certain US cities in the first half of the 20th century. Where interventions to improve water and sanitation were implemented in mixed household neighborhoods, African Americans benefited disproportionately from such improvements; as a result, racial mortality differentials diminished considerably.[37]

What knowledge can be gained from analyses of the diarrhea mortality decline in Stockholm that can be of use for countries with high levels of diarrhea mortality today? First, the explanation of the McKeown thesis for the decline of mortality[17] can be questioned regarding diarrhea. It seems evident that economic development per se does not bring about a reduction in diarrhea mortality. Economic improvement may contribute to mortality decline, but it needs to be translated into specific interventions that affect risk factors or causes of mortality. In that regard, our findings are more in line with those of Szreter, highlighting the importance of specific public health interventions (e.g., improved water and sanitation) rather than just economic improvement.[18,19]

Furthermore, our results support the hypotheses of Nathanson,[20] who stated that public health policies play a critical role in disease prevention and that the implementation of such policies is facilitated in strong, centralized states. Sweden was a precise example of a strong, centralized state that made the implementation possible. The enforcement and everyday implementation of practical public health policies, such as the removal of fecal matter and garbage, may be one key to reducing exposure to infectious agents from the fecally contaminated environment. The implementation of such policies needs to be guided by appropriate local research. Again, one reason for the decline in diarrhea mortality in Stockholm was probably the wide coverage of both water and sanitation interventions for all segments of the population. Therefore, in countries with high mortality, public health interventions need to be well organized and extensive if they are to have a substantial impact.

Second, in spite of the powerful interventions and action that took place, the decline of diarrhea mortality in Stockholm took quite some time. This demonstrates the need for patience when evaluating large-scale intervention projects in poor countries today. It may also be difficult to link the effect of 1 specific action to reduced morbidity and mortality rates, since these are the product of many different causes.

Third, interventions to reduce inequalities in child mortality ideally should help lower socioeconomic groups more than, or at least as much as, higher socioeconomic groups. This may be obvious, but it seldom happens in poor countries today. Since higher social classes have lower mortality, improvements in the average level of health in a country depend on wide coverage of interventions that have an impact among the lower social classes—for instance, wide coverage of improved water and sanitation and removal of environmental contamination. In our example from Stockholm at the turn of the 20th century, a general approach combined to some extent with targeted interventions for high-risk groups succeeded in benefiting lower socioeconomic groups as much as, or more than, higher socioeconomic groups, albeit with a time lag. In addition, as the example in our study suggests, improved access to piped water may be more effective if implemented in a comprehensive setting as part of a broader package of improved sanitation and handling of excreta, increased awareness of personal hygiene and food handling, and general socioeconomic development. We believe that further analysis of socioeconomic patterns in specific aspects of the historical decline of child mortality may contribute to knowledge on interventions and policies to improve equity in child survival. ■


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## Contributors

B. Burström and G. Macassa developed the study and performed the quantitative analyses. B. Burström wrote the article. L. Öberg provided the qualitative analyses and background information. E. Bernhardt and L. Smedman provided further interpretation of the results of the study. All authors assisted in revising the article and contributed to formulating the study objectives.

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